THE SCALE FACTORY

Custom CentOS AMI **builds on AWS**_

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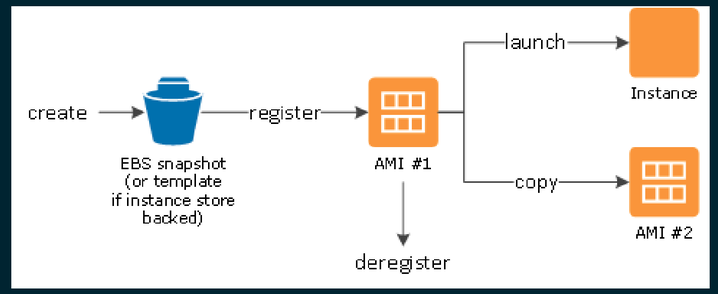
About **me_**

- Senior IT Consultant at The Scale Factory (DevOps consultancy and AWS partner)
- IT system engineering background with extensive Linux and virtualization experience
- Open source contributor and supporter
- Certifications and competencies: AWS, CKA and RHEL
- Fan of automation/simplifying things, hiking, cycling and travelling

Today's **agenda_**

- AMI and how to use it
- Background and motivation
- Building your own AMI
- Our solution and used tools
- Demo
- Conclusions

AMI and its **lifecycle_**

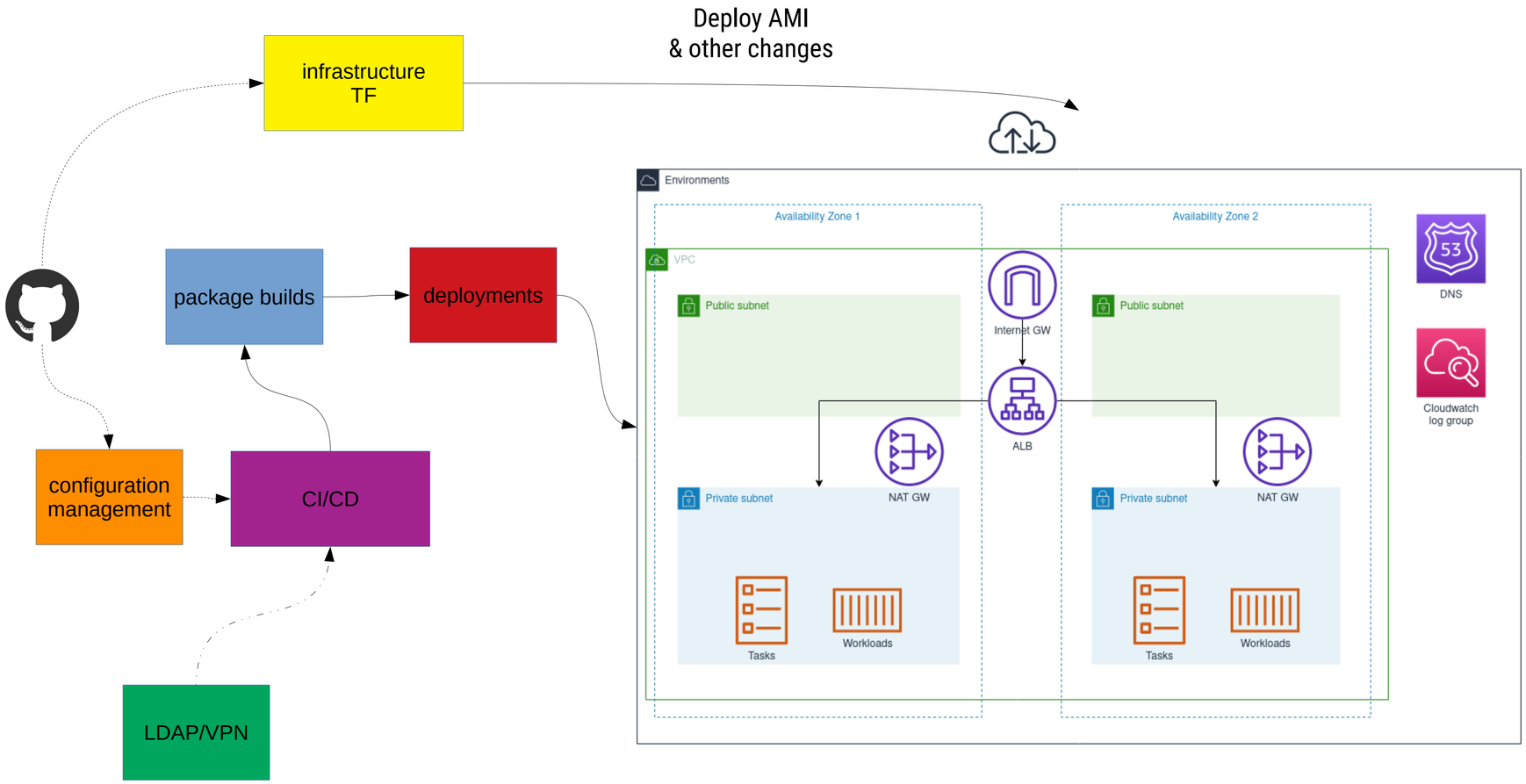


- Machine image – formats: AMIs for EC2, VMDK/VMX files for VMware, OVF exports for VirtualBox, etc.
- AMI (Amazon Machine Image) – template for the root volume of the instance (EBS snapshot).
- Create own AMI – using existing one as base or create one.
- Sharing it with others or disseminate using market space ecosystem.
- De-registering AMI and clean-up.

Motivation for custom AMI_

- System hardening
- Latest OS patches
- Configuration management bootstrapping
- Quicker instance spin-ups
- Other customisations, etc.
- ReadyScale platform

ReadyScale architecture_



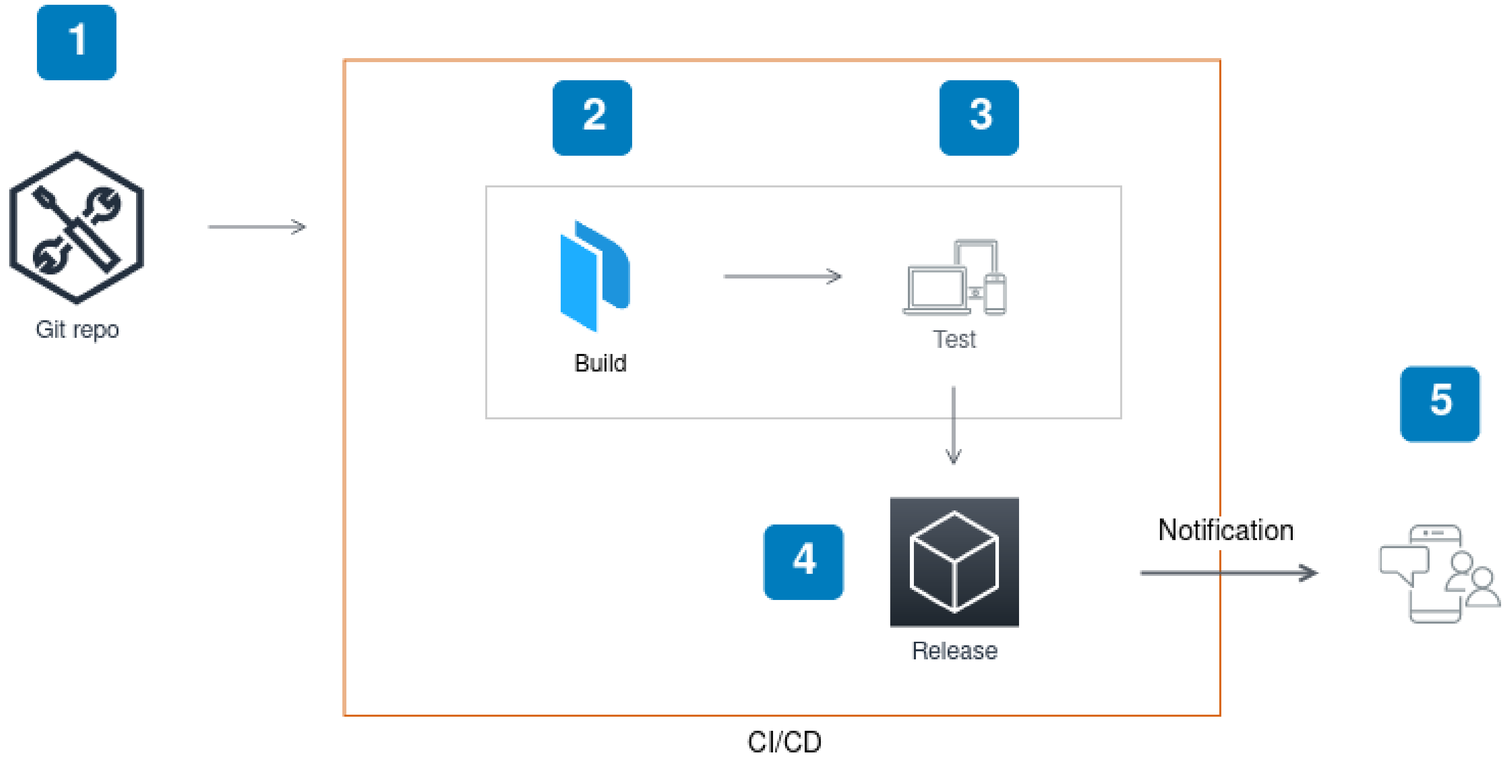
Ecosystem and tools_

- CentOS/RHEL as runtime and build OS
- HashiCorp Packer for building and customising
- Kitchen Test suite with GOSS tests
  - Native provisioner: https://github.com/YaleUniversity/packer-provisioner-goss
- `aws-cli` for managing temporary SSH keys
- Code in GitHub/GitLab
- Pipeline triggered on push events
- Slack notifications
- Automated AMI publishing
- Secrets and encrypted storage

Building custom **AMIs**_

- A machine image – single static unit that contains a pre-configured operating system and installed software for VMs
- Based on existing AMIs
- EC2 image builder (OS limitations)
- VM import (two phases: local build + import)
- Build our own from scratch in AWS

AMI build **architecture_**



Automation and pipelines_

- Started with Jenkins
- Migrated to GitHub Actions (GitLab CI/CD)
- Containers as build images
- YAML configuration manifests
- Visibility and good feedback loop to repository
- Reproducible artefacts

```
.gitlab-ci.yml:
---------------
image: "centos:latest"

variables:
    PACKER_VER: '1.5.1'

before_script:
  - dnf install -y make unzip jq gcc redhat-rpm-config ruby ruby-devel rubygem-bundler python3-pip
  - pip3 install awscli
  - curl https://releases.hashicorp.com/packer/${PACKER_VER}/packer_${PACKER_VER}_linux_amd64.zip -o - > /tmp/packer.zip
  - unzip -d /usr/bin /tmp/packer.zip

stages:
    - test
    - build

check:
    except:
        refs:
            - master
    stage: test
    script:
    - make -v
    - aws --version
    - packer -v
    - aws s3 ls


create:
    only:
        refs:
            - master
    stage: build
    script:
    - export AWS_SG_ID=sg-ffffffffffffffff
    - make build
    - 'export AWS_DEFAULT_REGION=$(cat manifest.json | jq -r .builds[0].artifact_id | cut -d: -f1)'
    - 'export AWS_AMI_ID=$(cat manifest.json | jq -r .builds[0].artifact_id | cut -d: -f2)'
    - make test
```

Building using **Packer_**

- Hashicorp Packer is a good option (open, mature, extensible and portable)
- Open-source tool for creating identical machine images for multiple platforms from a single source configuration
- Features and attributes:
  - Integration with CD/CD system and appliance creation
  - Wide range of builders/plugins, parallel builds
  - Testability and manifest validation
  - Structured configuration
  - Simple, lightweight and performant

- Alternatives are more opinionated and have less open/pluggable architecture (LinuxKit, Boxfuse, ...)

build.json 1/2:

```
---------------
{
…
    "builders": [
        {
            "ami_name": "foundation_ami_centos8_hvm_ebs_{{ user `BuildTime` }}",
            "ami_virtualization_type": "hvm",
            "ena_support": true,
            "instance_type": "t2.micro",
            "sriov_support": true,
            "ssh_username": "ec2-user",
            "type": "amazon-ebssurrogate",

            "source_ami_filter": {
                "filters": {
                    "name": "RHEL-8.1*",
                    "architecture": "x86_64",
                    "virtualization-type": "hvm",
                    "root-device-type": "ebs"
                },
                "owners": [ "309956199498" ],
                "most_recent": true
            },

            "launch_block_device_mappings": [
                {
                    "volume_type": "gp2",
                    "device_name": "{{ user `DeviceName` }}",
                    "delete_on_termination": true,
                    "volume_size": 20
                }
            ],

            "ami_root_device": {
                "delete_on_termination": true,
                "device_name": "/dev/xvda",
                "source_device_name": "{{ user `DeviceName` }}",
                "volume_size": 20,
                "volume_type": "gp2"
            },
…
}
```

build.json 2/2:

```
{
…
            "run_tags": {
                "Name": "PackerBuilder C8 {{ user `BuildTime` }}"
            },
            "ami_regions": [ "{{ user `build_region` }}" ],
            "ami_groups": [ "all" ],
            "snapshot_groups": [ "all" ]
        }
    ],

    "provisioners": [
        {
            "inline": "mkdir {{ user `BuildDirectory` }}",
            "type": "shell"
        },
        {
            "destination": "{{ user `BuildDirectory` }}",
            "source": "files",
            "type": "file"
        },
        {
            "destination": "{{ user `BuildDirectory` }}/build.sh",
            "source": "build.sh",
            "type": "file"
        },
        {
            "inline": "sudo {{ user `BuildDirectory` }}/build.sh {{ user `DeviceName` }} {{ user `BuildDirectory` }}",
            "type": "shell"
        }
    ],

    "post-processors": [
    {
      "type": "manifest",
      "output": "manifest.json",
      "strip_path": true
    }
  ]
…
}
```

```
build.sh:
---------
...
RELEASE="http://mirror.centos.org/centos/8/BaseOS/x86_64/os/Packages/centos-release-8.1-1.1911.0.8.el8.x86_64.rpm"

# Create arrays of packages to manage
mapfile UNNECESSARY < "${BUILD_DIRECTORY}/files/packages_remove"
mapfile REQUIRED < "${BUILD_DIRECTORY}/files/packages_install"

# Partition EBS volume
parted -a optimal "${DEVICE}" < "${BUILD_DIRECTORY}/files/parted.conf"
partprobe
# Show Partitions
parted -l "${DEVICE}"
# Format main partition as XFS
mkfs.xfs -L root "${DEVICE}3"
mkdir -p "${ROOTFS}"
mount "${DEVICE}3" "${ROOTFS}"
# Format swap
mkswap "${DEVICE}2"

### Basic CentOS Install
rpm --root=$ROOTFS --initdb
rpm --root="${ROOTFS}" -ivh --nodeps "${RELEASE}"
rm -rf /etc/yum.repos.d/*
dnf install -y http://mirror.centos.org/centos/8/BaseOS/x86_64/os/Packages/centos-gpg-keys-8.1-1.1911.0.8.el8.noarch.rpm
dnf install -y http://mirror.centos.org/centos/8/BaseOS/x86_64/os/Packages/centos-repos-8.1-1.1911.0.8.el8.x86_64.rpm
# Install base system
dnf --installroot=$ROOTFS --nogpgcheck -y groupinstall core
dnf --installroot=$ROOTFS install -y http://mirror.centos.org/centos/8/BaseOS/x86_64/os/Packages/centos-repos-8.1-1.1911.0.8.el8.x86_64.rpm

# Add required deps

# Yum S3 iam repo
cp "${BUILD_DIRECTORY}/files/repos/yum-plugin-s3-iam.repo" "${ROOTFS}/etc/yum.repos.d/yum-plugin-s3-iam.repo"

# Install necessary packages
dnf --installroot=$ROOTFS -y install https://dl.fedoraproject.org/pub/epel/epel-release-latest-8.noarch.rpm
dnf --installroot=$ROOTFS --nogpgcheck -y install "${REQUIRED[@]/$'\n'/}"
# Remove unnecessary packages
dnf --installroot=$ROOTFS -C -y remove "${UNNECESSARY[@]/$'\n'/}" --setopt="clean_requirements_on_remove=1"
...
```

Testing AMIs **using GOSS_**

- Opensource & written in Golang
- YAML based serverspec alternative
- Test generation from current state
- Fast and ‘small’ binary footprint
- Wide community support and contributions
- Testing limitations: only Linux + related package/services

```
# test/integration/ami/goss/test1.yml 1/2:
---
file:
    /tmp:
        exists: true
        mode: "1777"
        owner: root
        group: root
        filetype: directory
        contains: []
    /tmp/bootstrapped:
        exists: true
        contains: ['**bootstrapped**']
    /usr/bin/aws:
        exists: true
        mode: "0755"
        owner: root
        group: root
        filetype: file
        contains: []
user:
    ec2-user:
        exists: true
        uid: 1000
        gid: 1000
        groups:
            - ec2-user
        home: /home/ec2-user
process:
    sshd:
        running: true
port:
    tcp:22:
        listening: true
        ip:
            - '0.0.0.0'
```

```
# test/integration/ami/goss/test1.yml 2/2:
---
package:
    centos-release:
        installed: true
        versions:
            - '8.1'
addr:
    tcp://google.com:22:
        reachable: false
        timeout: 1000
    tcp://google.com:443:
        reachable: true
        timeout: 1000
command:
    pip3 -V:
        exit-status: 0
        stdout:
            - 'pip 9.0.3 from /usr/lib/python3.6/site-packages (python 3.6)'
        stderr: []
        timeout: 10000
    aws --version:
        exit-status: 0
        stdout:
            - 'aws-cli/1.17.6'
        stderr: []
        timeout: 10000
mount:
    /dev:
        exists: true
        opts:
            - rw
            - nosuid
        source: devtmpfs
        filesystem: devtmpfs
```

Time for
DEMO!_

Conclusions_

& takeaways

- Simple, quick, portable and reproducible workflow
- Automation, flexibility and high deployment cadence
- Wide support for various AWS builders (amazon-ebs|instance|chroot|ebssurrogate)
- Machine readable/generated outputs – pipeline stages and testing
- Kitchen Testing EC2 driver sometimes breaks
- Native provisioner (no aws-cli and keys generation)
- Missing CentOS 8.x base AMI*

Questions / discussion_

& resources

- *"Make things as simple as possible, but not simpler."* A. Einstein
- Twitter: @_MarkoB
- GitHub / GitLab: @mbevc1
- LinkedIn: https://www.linkedin.com/in/marko-bevc-245271118/
- Resources:
  - https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/AMIs.html
  - https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/creating-an-ami-ebs.html
  - https://www.packer.io/intro/getting-started/build-image.html
  - https://github.com/aelsabbahy/goss
  - https://github.com/ahelal/kitchen-goss